Revisiting the Blue Ribbon Panel:
Recommendations on Ocean Acidification

Chapter 6 – Adaptation and Remediation

What did the Blue Ribbon Panel say about adaptation and remediation in 2012?

Washington State needs to use a wide range of approaches to adapt to and remediate the impacts of ocean acidification in order to limit future losses of shellfish and other key marine resources. The Panel recommended preserving and enhancing the resilience of native shellfish and the ecosystems they depend on, and implementing a mix of innovative approaches and technologies to maintain and enhance cultivated shellfish production. These recommendations require collaboration between the private sector, nongovernmental organizations, academia and state and tribal governments.

What's been done since 2012, what's next, and should we revise the recommended actions?

Proposed changes to action language are underlined. New Actions are shown in **bold** text.

Strategy 6.1 – Remediate seawater chemistry

ACTION with proposed changes		PROGRESS SINCE 2012	WHAT'S NEXT
6.1.1 [KEA]	Develop land and aquatic vegetation-based systems of remediation for use in upland habitats and in shellfish areas.	Multi-year experiments are being conducted to test use of vegetation-based systems for remediation.	Use findings from research to develop implementable projects that use vegetation-based systems for remediation.
6.1.2	Maintain and expand shellfish production to support healthy marine waters.	Puget Sound Action Agenda and Washington Shellfish Initiative, among other efforts, are focused on maintaining and expanding shellfish production.	Continue to maintain and expand shellfish production.
6.1.3	Use shells in targeted marine areas to remediate impacts of local acidification on shellfish.	Reviewed possibility of commercial shell recycling pilot program, which identified many concerns with a commercial recycling approach.	Identify local opportunities to retain and use shell in key marine areas rather than relying on commercial sources.
NEW ACTION 6.1.4	**Identify and support research and implementation of activities to increase the marine ecosystem's ability to capture and store carbon from atmospheric sources.**		Identify activities that could increase ability to capture and store atmospheric carbon.
NEW ACTION 6.1.5	**In watersheds where models show land-based pollution contributes to local acidification, implement seaweed recycling programs between local shellfish farms and terrestrial farms.**		Assess benefits and risks of seaweed harvest at shellfish farms, quantify value of organic material to farmers in the watershed, and develop potential cost structure for marketing biomass to farmers. Contingent on results of Action 7.2.1.

Strategy 6.2 – Increase the capacity of resource managers and the shellfish industry to adapt to ocean acidification

ACTION with proposed changes		PROGRESS SINCE 2012	WHAT'S NEXT
6.2.1 [KEA]	Ensure continued water quality monitoring at the six existing shellfish hatcheries and rearing areas to enable real-time management of hatcheries under changing pH conditions.	Water quality monitoring is ongoing at the six existing shellfish hatcheries and rearing areas. Updated equipment and new pH sensors installed and funding received to add new sites.	Continue water quality monitoring.
6.2.2	Expand the deployment of instruments and chemical monitoring to post-hatchery shellfish facilities and farms.	Monitoring instruments deployed in shellfish facilities across the state with additional work occurring in Alaska and California.	Continue expanding deployment of instruments and operations of current instruments.
6.2.3 [KEA]	Investigate and develop commercial-scale water treatment methods or hatchery designs to protect larvae from corrosive seawater.	Developed new hatchery methods to mitigate corrosive conditions; tests are ongoing for new monitoring and treatment methods.	Continue developing new monitoring and treatment methods to increase implementation of effective methods.
6.2.4	Develop and incorporate acidification indicators and thresholds to guide adaptive action for species and places.	Developed oyster bioassays and working to use pteropods as biological indicator for ocean acidification.	Continue developing other indicators and working to incorporate thresholds into action.
NEW ACTION 6.2.5	**Investigate relationship between ocean acidification resistance in larval shellfish and feed quantity and quality, to assess potential to strengthen young shellfish through adjusted feeding regimes.**		A study of the effects of feed regimes on growth, survival, and physiological responses to these stresses may lead to practical and useful adaptation strategies for shellfish and other species.

Strategy 6.3 – Enhance resilience of native and cultivated shellfish populations and ecosystems on which they depend

ACTION with proposed changes		PROGRESS SINCE 2012	WHAT'S NEXT
6.3.1	Preserve Washington's existing native sea grass and kelp populations and, where possible, restore these populations.	Developed a strategy to increase eelgrass by 20% in Puget Sound by 2020 and working on restoration practices, techniques, and necessary information to restore populations. Developed kelp recovery plan and initiated experiment to optimize kelp restoration techniques.	Continue refining restoration practices and techniques, and transplant eelgrass and kelp to meet stated restoration goals. Improve monitoring protocols to better identify vulnerable populations of eelgrass and kelp.
6.3.2 [KEA]	Identify, protect, and manage refuges for organisms vulnerable to OA and other stressors.	Monitoring potential sites to act as oyster refuges and forming a workgroup to identify criteria and select locations to apply remediation strategies.	Continue progress of selecting refuge sites and ensure their protection and management.

ACTION with proposed changes		PROGRESS SINCE 2012	WHAT'S NEXT
6.3.3	Support restoration and conservation of native oysters.	Restored 60 acres of native oyster habitat in Puget Sound.	Continue restoration efforts to achieve the goal of restoring 100 acres in Puget Sound, and pursue restoration on the Washington Coast.
6.3.4	Use conservation hatchery techniques to maintain the genetic diversity of native shellfish species.	Built a conservation hatchery that is using techniques to maintain the genetic diversity of native shellfish species.	Continue operations of the conservation hatchery and its work to promote genetic diversity.
6.3.5	Investigate genetic mechanisms and selective breeding approaches for acidification tolerance in shellfish and other vulnerable marine species.	Research underway on ocean acidification impacts to gene expression, breeding resistance to ocean acidification and species capacity for adaptation	Continue current research efforts.
NEW ACTION 6.3.6	**Identify and protect intertidal and nearshore habitats that support organisms vulnerable to OA and those that mitigate OA impacts.**		Identify lead for this effort to inform new and ongoing protection and restoration efforts.
NEW ACTION 6.3.7	**Review and evaluate current regulations governing the culture and harvest of aquatic vegetation and develop recommendations for regulatory changes, if needed.**		A thorough, multi-agency, multi-disciplinary review could generate proposed adjustments that better serve conservation and restoration goals as well as ocean acidification remediation goals.